

WHAT IS CLAIMED IS:

1. An image processing apparatus wherein a first processing circuit and a second processing circuit are connected in m bits, the apparatus comprising:

5 replacement means for replacing lower n bits of an m-bit image signal with n-bit additional information, and outputting an m-bit conversion image signal;

error calculation means for calculating an error between the m-bit conversion image signal replaced by
10 the replacement means and the m-bit image signal before the replacement;

an error buffer for storing the error calculated by the error calculation means;

weight coefficient storage means for prestoring
15 a weight coefficient for calculating a weight error;

weight error calculation means for calculating a weight error by multiplying the error stored in the error buffer by the weight coefficient stored in the weight coefficient storage means;

20 error correction means for correcting the m-bit image signal before the replacement, using the weight error calculated by the weight error calculation means; and

extraction means for extracting the lower n bits
25 of the m-bit conversion image signal replaced and output from the replacement means.

2. An image processing apparatus according to

claim 1, wherein the m-bit conversion image signal is only a specific color component of color-separated color image signals.

5 3. An image processing apparatus according to claim 1, wherein the m-bit image signal before the replacement is a color difference component of a color image signal represented by a luminance and a color difference.

10 4. An image processing apparatus wherein a first processing circuit and a second processing circuit are connected in m bits, the apparatus comprising:

multi-value means for subjecting an m-bit image signal to a multi-value process and converting the m-bit image signal to an m-n bit image signal;

15 error calculation means for calculating an error between the m-n bit image signal multi-value-processed by the multi-value means and the m-bit image signal before subjected to the multi-value process;

20 an error buffer for storing the error calculated by the error calculation means;

weight coefficient storage means for prestoring a weight coefficient for calculating a weight error;

25 weight error calculation means for calculating a weight error by multiplying the error stored in the error buffer by the weight coefficient stored in the weight coefficient storage means;

error correction means for correcting the m-bit

image signal before the multi-value process, using the weight error calculated by the weight error calculation means;

5 addition means for adding n-bit information to the m-n bit image signal multi-valued-processed by the multi-value means, and outputting an m-bit conversion image signal;

10 first extraction means for extracting information bits of n bits from the m-bit conversion image signal output from the addition means; and

 second extraction means for extracting image bits of m-n bits from the m-bit conversion image signal output from the addition means.

15 5. An image processing apparatus wherein a first processing circuit and a second processing circuit are connected in m bits, the apparatus comprising:

 first replacement information pixel determination means for specifying n pixels within $j \times k$ pixels;

20 replacement means for replacing, where the first replacement information pixel determination means has determined that process target pixels are specific n pixels, specific bits of an m-bit image signal with specific bits of n-bit additional information, and outputting an m-bit conversion image signal;

25 second replacement information pixel determination means for specifying n pixels within $j \times k$ pixels; and information bit extraction means for extracting,

where the second replacement information pixel
determination means has determined that process target
pixels are specific n pixels, specific bits of the
m-bit conversion image signal output from the
5 replacement means, and reconstructing information bits
of n bits within the $j \times k$ pixels.

6. An image processing apparatus wherein a first
processing circuit and a second processing circuit are
connected in m bits, the apparatus comprising:

10 first replacement information pixel determination
means for specifying n pixels within $j \times k$ pixels;

replacement means for replacing, where the first
replacement information pixel determination means has
determined that process target pixels are specific n
15 pixels, specific bits of an m -bit image signal with
specific bits of n -bit additional information, and
outputting an m -bit conversion image signal;

error calculation means for calculating an error
between the m -bit conversion image signal replaced by
20 the replacement means and the m -bit image signal before
the replacement;

an error buffer for storing the error calculated
by the error calculation means;

weight coefficient storage means for prestoring
25 a weight coefficient for calculating a weight error;

weight error calculation means for calculating
a weight error by multiplying the error stored in the

error buffer by the weight coefficient stored in the weight coefficient storage means;

error correction means for correcting the m-bit image signal before the replacement, using the weight error calculated by the weight error calculation means;

second replacement information pixel determination means for specifying n pixels within $j \times k$ pixels; and

information bit extraction means for extracting, where the second replacement information pixel determination means has determined that process target pixels are specific n pixels, specific bits of the m-bit conversion image signal replaced and output from the replacement means, and reconstructing information bits of n bits within the $j \times k$ pixels.

7. An image processing apparatus wherein a first processing circuit and a second processing circuit are connected in m bits, the apparatus comprising:

first replacement information pixel determination means for specifying n pixels within $j \times k$ pixels;

replacement means for replacing, where the first replacement information pixel determination means has determined that process target pixels are specific n pixels, lower n bits of an m-bit image signal with n-bit additional information, and outputting an m-bit conversion image signal;

error calculation means for calculating an error between the m-bit conversion image signal replaced by

the replacement means and the m-bit image signal before the replacement;

an error buffer for storing the error calculated by the error calculation means;

5 weight coefficient storage means for prestoring a weight coefficient for calculating a weight error;

weight error calculation means for calculating a weight error by multiplying the error stored in the error buffer by the weight coefficient stored in the
10 weight coefficient storage means;

error correction means for correcting the m-bit image signal before the replacement, using the weight error calculated by the weight error calculation means;

second replacement information pixel determination
15 means for specifying n pixels within $j \times k$ pixels; and

extraction means for extracting, where the second replacement information pixel determination means has determined that process target pixels are specific n pixels, the lower n bits of the m-bit conversion image
20 signal replaced and output from the replacement means.

8. An image processing apparatus wherein a first processing circuit and a second processing circuit are connected in 1 bits, the apparatus comprising:

multi-value means for subjecting an m-bit image
25 signal to a multi-value process and converting the m-bit image signal to an l-n ($n < l < m$) bit image signal;

error calculation means for calculating an error between the 1-n bit image signal multi-value-processed by the multi-value means and the m-bit image signal before subjected to the multi-value process;

5 an error buffer for storing the error calculated by the error calculation means;

weight coefficient storage means for prestoring a weight coefficient for calculating a weight error;

weight error calculation means for calculating
10 a weight error by multiplying the error stored in the error buffer by the weight coefficient stored in the weight coefficient storage means;

error correction means for correcting the m-bit image signal before the multi-value process, using the
15 weight error calculated by the weight error calculation means;

addition means for adding n-bit information to the 1-n bit image signal multi-valued-processed by the multi-value means, and outputting an 1-bit conversion
20 image signal;

first extraction means for extracting information bits of n bits from the 1-bit conversion image signal output from the addition means; and

second extraction means for extracting image bits
25 of 1-n bits from the 1-bit conversion image signal output from the addition means.

9. An image processing apparatus wherein a first

processing circuit and a second processing circuit are connected in m bits, the apparatus comprising:

multi-value dithering means for subjecting an m-bit image signal to a multi-value process and
5 converting the m-bit image signal to an m-n bit image signal;

addition means for adding n-bit information to the m-n bit image signal multi-valued-processed by the multi-value dithering means, and outputting an m-bit
10 conversion image signal;

first extraction means for extracting information bits of n bits from the m-bit conversion image signal output from the addition means; and

second extraction means for extracting image bits
15 of m-n bits from the m-bit conversion image signal output from the addition means.

10. An image processing apparatus wherein a first processing circuit and a second processing circuit are connected in m bits, the apparatus comprising:

20 difference information extraction means for extracting a difference of n-bit additional information of successive two pixels;

replacement means for replacing where the difference extracted by the difference information
25 extraction means is not 0, n bits from lower n+1 bits of an m-bit image signal with additional information, a least significant bit with 1, and also replacing, where

the difference extracted by the difference information extraction means is 0, the least significant bit with 0, and outputting an m-bit conversion image signal;

error calculation means for calculating an error
5 between the m-bit conversion image signal replaced by the replacement means and the m-bit image signal before the replacement;

an error buffer for storing the error calculated by the error calculation means;

10 weight coefficient storage means for prestoring a weight coefficient for calculating a weight error;

weight error calculation means for calculating a weight error by multiplying the error stored in the error buffer by the weight coefficient stored in the
15 weight coefficient storage means;

error correction means for correcting the m-bit image signal before the replacement, using the weight error calculated by the weight error calculation means; and

20 extraction means for extracting the lower n bits of the m-bit conversion image signal replaced and output from the replacement means.

11. An image processing apparatus wherein a first processing circuit and a second processing circuit are
25 connected in m bits, the apparatus comprising:

first replacement bit determination means for specifying n bits in an m-bit image signal;

replacement means for replacing the n bits specified by the first replacement bit determination means with n-bit additional information, and outputting an m-bit conversion image signal;

5 error calculation means for calculating an error between the m-bit conversion image signal replaced by the replacement means and the m-bit image signal before the replacement;

 an error buffer for storing the error calculated
10 by the error calculation means;

 weight coefficient storage means for prestoring a weight coefficient for calculating a weight error;

 weight error calculation means for calculating a weight error by multiplying the error stored in the
15 error buffer by the weight coefficient stored in the weight coefficient storage means;

 error correction means for correcting the m-bit image signal before the replacement, using the weight error calculated by the weight error calculation means;

20 second replacement bit determination means for specifying n bits in the m-bit image signal; and

 extraction means for extracting the n bits specified by the second replacement bit determination means from the m-bit conversion image signal output
25 from the replacement means.

12. An image processing apparatus wherein a first processing circuit and a second processing circuit are

connected in m bits, the apparatus comprising:

conversion means for converting n-bit additional information to a random n-bit string;

5 replacement means for replacing lower n bits of an m-bit image signal with the random n-bit string converted by the conversion means, and outputting an m-bit conversion image signal;

error calculation means for calculating an error between the m-bit conversion image signal replaced by the replacement means and the m-bit image signal before the replacement;

an error buffer for storing the error calculated by the error calculation means;

15 weight coefficient storage means for prestoring a weight coefficient for calculating a weight error;

weight error calculation means for calculating a weight error by multiplying the error stored in the error buffer by the weight coefficient stored in the weight coefficient storage means;

20 error correction means for correcting the m-bit image signal before the replacement, using the weight error calculated by the weight error calculation means;

25 extraction means for extracting lower n bits of the m-bit conversion image signal replaced and output from the replacement means; and

inverse conversion means for subjecting the lower n bits extracted by the extraction means to an inverse

conversion of the conversion by the conversion means.